IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
McMILLAN et al.

Serial No.: 10/720,344
Filed: 11/25/03
Atty. Docket: 84714

Group: 2624
Examiner: LIEW, Alex Kok Soon

Title: WAVELET COMPRESSION

PRIORITY CLAIM SUBMISSION AND CERTIFIED COPY

Date: February 25, 2008

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

It is respectfully requested that under the provisions of 35 USC 119/365, this application be given the benefit of the foreign filing date of the following, a certified copy of which is attached hereto:

Application No.	Country of Origin	Filed
0227743.2	**Great Britain**	**11/28/02**

Respectfully submitted,

W. Warren Taltavull
Reg. No. 25647

MANELLI DENISON & SELTER PLLC
Customer Number 20736
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The Patent Office
Concept House
Cardiff Road
Newport
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NP10 8QQ

the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) the Deregulation and Contracting Out Act 1994, to sign and issue certificates on behalf of Comptroller-General, hereby certify that annexed hereto is a true copy of the documents originally filed in connection with the patent application identified therein together with the statement of inventorship and of right to grant of a Patent (Form 7/77), which was subsequently filed.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 19 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Signed

Dated 22 October 2003

Patents Form 1/77

Patents Act 1977
(Rule 16)

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference DY 3052

2. Patent application number *(The Patent Office will fill in this part)* 0227743.2 28 NOV 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

ROLLS-ROYCE plc
65 BUCKINGHAM GATE
LONDON
SW1E 6AT
GREAT BRITAIN

Patents ADP number *(if you know it)* 3970002

If the applicant is a corporate body, give the country/state of its incorporation GREAT BRITAIN

4. Title of the invention WAVELET COMPRESSION

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

M A GUNN AND V J BIRD
ML-9
ROLLS-ROYCE plc
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DERBY
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Patents ADP number *(if you know it)* 3962001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	3
Claim(s)	1
Abstract	0
Drawing(s)	0

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	NO
Request for preliminary examination and search *(Patents Form 9/77)*	NO
Request for substantive examination *(Patents Form 10/77)*	NO
Any other documents *(please specify)*	NO

11. I/We request the grant of a patent on the basis of this application.

Signature: V J BIRD

Date: 28 NOVEMBER 2002

12. Name and daytime telephone number of person to contact in the United Kingdom: ANDREW LITTLE 01332 249397

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

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Patents Form 7/77

Patents Act 1977
(Rule 15)

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7/77

Statement of inventorship and of right to grant of a patent

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

   DY3052

2. Patent application number
   (if you know it)

   0227743.2

3. Full name of the or of each applicant

   ROLLS-ROYCE PLC

4. Title of the invention

   WAVELET COMPRESSION

5. State how the applicant(s) derived the right from the inventor(s) to be granted a patent

   BY VIRTUE OF SECTION 39(1)(a) OF THE PATENTS ACT 1977

6. How many, if any, additional Patents Forms 7/77 are attached to this form? 2
   (see note (c))

7. I/We believe that the person(s) named over the page *(and on any extra copies of this form)* is/are the inventor(s) of the invention which the above patent application relates to.

   Signature [signature] Date

   M A GUNN 11.12.2002

8. Name and daytime telephone number of person to contact in the United Kingdom

   T A LITTLE 01332 249397

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.

d) When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.

e) Once you have filled in the form you must remember to sign and date it.

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

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Patents ADP number *(if you know it)*:

Reminder

Have you signed the form?

WAVELET COMPRESSION

The present invention relates to a method of compressing visual image data.

In particular it concerns a method for speeding up the operation of a computer set a task f processing the visual image data without sacrificing the fidelity of the data in regions of special interest.

In modern computational mechanics, typically, but not exclusively using Finite Element techniques, solution parameters are tabulated for discrete points in the problem domain. A typical large dynamic analysis may have a complex 3D geometry modelled with a million elements, with results tabulated over a large number of time steps, thus creating a large four dimensional (4D) data set.

Consider for example, the problem of visualising a fan blade containment analysis of a large fan gas turbine engine. From an enormous 4D data set, a stress engineer must select appropriate cross-sections in order to visualise the most significant features as they change over the selected time frame. The choice of such cross-sections is usually subjective, based on experience and engineering intuition. However in models of very complex components which are subject to a range of loading conditions, it may be impossible to be certain that all the significant regions of the stress field have been inspected. Typically, the computer used to perform the calculations required for the analysis of the data set will be based around a high specification server, and the graphical information will be pushed down a network to engineer's local machine.

However, there are three practical disadvantages to this technique:

- the graphical computation can be time consuming wherein each cross-section through the model can take several minutes to load,
- selection of views is by trial and error, and
- interactive demands on the server interfere with its performance on the other large finite element analyses, which it is processing.

For the purpose of exploring the solution domain, faster computer response is desirable. Although this would seem to indicate that a computer system with improved server capability would provide the solution, in practice the better the server, the more complex will be the Finite Element Analyses submitted to it. That is the number and complexity of the problems submitted to the machine for analysis will expand to fill the available capacity. The result is often no improvement at all.

The present invention seeks to provide a real solution to this problem by implementing a process the effect of which is to spare the server from interactive demands, and make better use of the graphics capabilities of the local machines. A key feature underlying the invention is selective use of a lower fidelity model to process the data set for regions of the model where reduced resolution is acceptable, and the graphical display of a model of sufficiently reduced size could be managed by the local workstation.

According to a first aspect of the invention a computer system programmed to process a large image data set includes means for applying an image compression technique to selected portions of the data set whereby to reduce the period of time spent processing the whole data set.

Preferably the image compression technique comprises the use of wavelets. Wavelets have been used with great success for 2D (two dimensional) image compression, with compressions to 5% of original data still giving visually acceptable images. Thus it may be expected that for 4D (four dimensional) compression, a reduced model of 0.25% of the original size is practical. The wavelets method of compression has the advantage over other methods of image compression in that sharp contrasts are preserved. It is therefore expected that areas which would be of interest to a stress engineer, for example rapid changes in the stress field, high deformation rates, etc, would be preserved in high fidelity. The fidelity of the less interesting regions of the model would be sacrificed.

This feature of wavelets may be further harnessed, to give a basis on which some of the most significant cross-sectional views may be automatically computed and presented to the engineer at the beginning of the post-processing stage.

Application of wavelet compression to the problem prior to analysis, allows the finite element analysis solution to take place in high fidelity on the most significant geometric locations at the most significant points in time, while simultaneously reducing the fidelity elsewhere in the model. For example, in a fan blade containment analysis, most of the casing is not in the direct line of impact, and much of it experiences very little stress in comparison with the impact sites.

A reduction to 0.25% is also appropriate for analysis, and for post-processing, so that analysis times may be expected to be reduced to 0.000625% of the uncompressed original processing time. Corresponding reductions in the processing times of much bigger analyses may be contemplated. The former is not likely unless there is a lot of degeneracy in the problem, but the latter could mean that pre-processing time, ie man-hours spent constructing the finite element mesh, could be reduced.

CLAIMS

1 A computer system programmed to process a large image data set includes means for applying an image compression technique to selected portions of the data set whereby to reduce the period of time spent processing the whole data set.

2 A computer system as claimed in claim 1 wherein the image compression technique comprises the use of wavelets.

3 A computer system substantially as hereinbefore described.

4 A process for reducing the processing time of very large image data sets wherein data relating to less interesting regions of the image are compressed using an image compression technique.

5 A process for reducing the processing time of very large image data sets as claimed in claim 4 using a wavelets image compression technique.

6 A process for reducing the processing time of very large image data sets substantially as hereinbefore described.